Editorial

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All of the papers on concrete materials that have been published in *Magazine of Concrete Research* (MCR) can be regarded as dealing with some aspect of modern concrete. Therefore, the papers for this themed issue have been selected to illustrate current trends. As somebody who has worked for the ready-mixed concrete industry and been heavily involved in the preparation of British, European and international standards, the selection of papers includes some that support the needs of industry and standardisation. This themed issue on modern concrete is in two parts, each containing five papers.

The European Concrete Committee agreed in 2015 that durability should be specified by performance, but moving from the present approach – which is, in general, limiting values such as maximum water/cement ratio – to a performance approach has many technical difficulties and potential commercial risks. This change is likely to be a step-by-step process to build confidence and resolve the difficulties that will arise.

Models are needed to check the reliability of the performance criteria, but as the *Fédération Internationale du Béton* (fib) models for carbonation and chloride ingress are introduced into the International Organization for Standardization (ISO) standards, they are likely to be included in European standards not as the only model, but as an acceptable model. Standardisers agree that more research on models is needed to refine and improve existing models and to develop models for aspects of durability where there are none that are widely accepted by the engineering community.

The first paper is therefore one on modelling (Zhu *et al.*, 2019), which illustrates how research is developing more sophisticated models covering more than one aspect of durability. Modelling is seen by industry as a tool for standardisers when preparing standards and for experts when preparing the specification for special structures.

The second paper (Harrison, 2019) illustrates the problems associated with performance-related test methods. The standard chamber test for carbonation resistance has conditions that disadvantage cements that develop their resistance over

months rather than days, resulting in no fixed relationship between test results and reality. It took many years to resolve all the issues with compressive strength testing and therefore it should be anticipated that it will be several decades before the issues with performance-testing for durability are resolved.

Specifying resistance against acid attack is a challenge and this is illustrated in the third paper (Torres *et al.*, 2019). As a specifier, I would never consider specifying a concrete with a water/cement ratio of 0.83 for acid resistance yet this concrete performed better than one with a water/binder ratio of 0.28. This paper showed that in these concretes, only the binder was attacked by the acid and as the concrete with the water/cement ratio of 0.28 had a higher binder content, its loss of mass was higher. As only two concretes were tested, there are still many unanswered questions. For example, if the cement content of the reference concrete was kept the same but the water/cement ratio reduced, would the acid resistance improve?

Improving the sustainability of concrete solutions is a constant theme in MCR, with the focus often being on reducing the Portland cement clinker content of the cement or binder or using cements that do not contain Portland cement clinker. MCR has published numerous papers on geopolymers and a themed issue on modern concretes has to include such a paper. The one selected is 'Influence of calcium content on structure and strength of MSWI bottom ash-based geopolymer' (Huang *et al.*, 2019). This paper used municipal solid waste incineration bottom ash and normal temperatures for curing and while this paper showed that adequate strength for unreinforced elements could be achieved, the process requires a de-foaming pre-treatment. The low burning temperature of the bottom ash and the high organic content are reasons why this ash in Europe is classified as a hazardous waste and before such material will get included in specifications it will have to be proven that concrete made with such materials do not pose a hazard to the environment or human health. Most specifications for reinforced concrete ban the use of calcium chloride and for this reason products made from this particular geopolymer are likely to be limited to unreinforced products.

The last paper in the first part of the themed issue is on formwork pressures (Zhang *et al.*, 2019). From an industrial perspective, papers such as this have practical application. What it indicates – and the authors include a caveat that the test programme was limited to four walls – is that the safe assumption of fluid pressure when there is deep vibration may be too conservative.

The second part of the themed issue on modern concrete starts with three papers on fibre concrete. The first (Goaiz *et al.*, 2019) covers test methods for steel fibre-reinforced concrete. Three test methods were investigated, and they showed that the double punch test (DPT) gave similar results to the direct tensile test, but the DPT was easier to undertake than the direct tensile test. As predicted by the weakest-link theory, the splitting tensile test gave higher tensile strengths than the other two methods.

Two papers are included on carbon nanotubes, as this is an area that is still developing yet has the potential to lead to new forms of structure. The first paper (Ahmed *et al.*, 2019). This showed that in cement pastes the optimal mass of carbon nanotubes was in the range 0.05–0.10% by mass. The research reported in the other paper (Chen *et al.*, 2019) combined multi-wall carbon nanotubes (MWCNTs) and graphene nanoplatelets (GNP) in mortar composites. This research showed an excellent synergistic effect was generated through MWCNTs bridging adjacent GNP sheets and inhibiting their restacking and aggregation in the cement matrix, resulting in improved mechanical properties and greater volume stability.

The next paper (Adams *et al.*, 2019) starts with a problem faced by society; namely, upgrading the thermal performance of the existing housing stock. They researched both the properties of the ultra-lightweight foam concrete and the method of application and while they resolved some issues, there remained the issue of the foam concrete having adequate strength after carbonation.

The last paper in this themed issue illustrates why MCR exists – to share knowledge and interesting new ideas. This paper (Jang *et al.*, 2019) provides research data on the use of

superabsorbent polymer in fibre-reinforced mortars to reduce the water/binder ratio instead of using superplasticiser. The ability of the superabsorbent polymer to hold and then release water helped seal microcracks and counter the effects of poor curing.

As what is currently known as ‘modern concrete’ becomes mainstream, new ideas will appear and take the title, and MCR intends to be one of the vehicles that shares this new knowledge with the research community and industry.

REFERENCES

- Ahmed H, Bogas JA, Guedes M and Pereira MFG (2019) Dispersion and reinforcement efficiency of carbon nanotubes in cementitious composites. *Magazine of Concrete Research* **71**(8): 408–423, <https://doi.org/10.1680/jmacr.17.00562>.
- Chen YH, Lin SC, Wang JA, Hsu SY and Ma CCM (2019) Preparation and properties of graphene/carbon nanotube hybrid reinforced mortar composites. *Magazine of Concrete Research* **71**(8): 395–407, <https://doi.org/10.1680/jmacr.18.00070>.
- Goaiz HA, Farhan NA, Sheikh MN, Yu T and Hadi MNS (2019) Experimental evaluation of tensile strength test methods for steel fibre-reinforced concrete. *Magazine of Concrete Research* **71**(8): 385–394, <https://doi.org/10.1680/jmacr.17.00516>.
- Harrison TA (2019) Specifying resistance against carbonation-induced corrosion by performance. *Magazine of Concrete Research* **71**(7): 341–348, <https://doi.org/10.1680/jmacr.18.00397>.
- Huang G, Ji Y, Zhang L *et al.* (2019) Influence of calcium content on structure and strength of MSWI bottom ash-based geopolymers. *Magazine of Concrete Research* **71**(7): 362–372, <https://doi.org/10.1680/jmacr.17.00542>.
- Jang SJ, Yun HD, Kim SW, Park WS and Kobayashi K (2019) Properties of strain-hardening cement composites with superabsorbent polymer particles. *Magazine of Concrete Research* **71**(8): 437–448, <https://doi.org/10.1680/jmacr.18.00256>.
- Torres ALT, Souza LMS, Silva MIP and de Andrade Silva F (2019) Concrete degradation mechanisms by sulfuric acid attack. *Magazine of Concrete Research* **71**(7): 349–361, <https://doi.org/10.1680/jmacr.18.00194>.
- Zhang W, Chen Y, Li Y and Huang J (2019) Study of formwork pressure of wall under ultra-deep vibration. *Magazine of Concrete Research* **71**(7): 373–384, <https://doi.org/10.1680/jmacr.17.00324>.
- Zhu X, Zi G, Sun L and You I (2019) A simplified probabilistic model for the combined action of carbonation and chloride ingress. *Magazine of Concrete Research* **71**(7): 327–340, <https://doi.org/10.1680/jmacr.18.00140>.